VILLAGE OF MADOC

fuel oil contamination of a private well water supply

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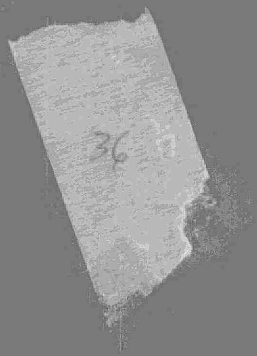

Ministry of the Environment
Ontario

MINISTRY OF THE ENVIRONMENT

VILLAGE OF MADOC

FUEL OIL CONTAMINATION OF A PRIVATE WELL WATER SUPPLY

R. E. McArthur

1973

MINISTRY OF THE ENVIRONMENT

VILLAGE OF MADOC - FUEL OIL CONTAMINATION OF A PRIVATE WELL WATER SUPPLY

INTRODUCTION

On April 10, 1973, Mrs. G. Paranuik requested that the Water Quantity Management Branch conduct an investigation to determine the source of the fuel oil odours which the Paranuiks had detected in their well water earlier that day. Mr. Paranuik was particularly concerned about the loss of his well water supply since the chlorine in the municipal supply, which provided part of his domestic water requirement at this time, is toxic to minnows and therefore unacceptable for his bait farming operation.

According to Mr. Paranuik, an oil delivery was made to the Madoc Baptist Church (formerly Madoc Town Hall) by a Gulf agency plant operated by Mr. D. Ash a few days previous to the development of fuel oil odours in his well water. Mr. M. Johnson, who was working in the church, discovered a leak in the 300 gallon fuel oil storage tank on April 9, 1973. The Village requested that the oil be pumped from the faulty tank. Mr. B. Carswell, who undertook this work reported that only 12 gallons were recovered. Thus, approximately 280 gallons of fuel oil were lost at the Madoc Baptist Church immediately before the odours of fuel oil were noticed in the Paranuik well.

On April 18, 1973, an investigation was conducted in the vicinity of the fuel oil spill. The faulty tank was located in the church basement. Although the tank was situated inside the building, facilities for external venting were not apparent. The tank had an obvious hole in the bottom of one end and soil beneath the tank's original position was damp and smelled strongly of fuel oil. Fuel oil tanks at other residences upgradient from the Paranuik well were inspected and found to be dry and in sound condition.

At this time, a levelling and sampling survey was conducted along St. Lawrence Street in the vicinity of the fuel oil spill. Figure 1 represents the residences and water wells in this area.

HYDROGEOLOGY

As can be seen from the summary of water well records presented in Table 1, wells in the spill area penetrate 10 to 20 feet of coarse overburden materials and obtain suitable water supplies from an aquifer in the bedrock. A levelling survey involving these wells revealed static water elevations ranging from 555 feet in the Bateman well to 550 feet in the well on the Forbes property. From the static elevation data, it is apparent that ground water flow in the vicinity of the fuel oil loss at the Madoc Baptist Church is directly toward the Paranuik well. Ground water in this area ultimately discharges to the stream.

WATER QUALITY

The results of chemical analyses of water samples taken from each of the wells in Figure 1 are presented in

Table 2.

Pure fuel oil was obtained directly from the surface of the Paranuik well. This fuel oil demonstrated an identical chromatograph trace to that of a sample of oil which was taken from the bottom of the faulty tank at the Madoc Baptist Church. However, only petroleum product odours were apparent in samples taken from the Paranuik distribution system, even after pumping for 75 minutes. Thus, the bulk of the fuel oil ponded on the surface of the water table and the low intake setting of the pump in the Paranuik well permitted only limited amounts of the contaminant to gain access to the distribution system.

Fuel oil was not detected in any of the other wells sampled.

REMEDIAL ACTION

On April 18, 1973, representatives of municipal council were advised to pump the hydrocarbon phase from the water table surface at the Paranuik well to eliminate the possibility of the contaminant migrating to wells further downgradient, and to reduce the concentration of the contaminant in the Paranuik well.

The village superintendent commenced pumping of the contaminant from the Paranuik well on April 19, 1973. Pumping was continued until a distinct hydrocarbon phase was no longer evident. According to village officials, subsequent pumping has yielded only small amounts of fuel oil. On June 18, 1973, the odours of fuel oil were still quite apparent according to Mr. Paranuik.

DISCUSSION

Since petroleum hydrocarbons are sparingly soluble, the residual contaminant adhering to soil particles and rock surfaces will be released to the ground-water environment very gradually. Therefore, wells which are directly downgradient from a hydrocarbon spill may yield water containing small amounts of hydrocarbon contaminants, at least occasionally, for a long period of time. Hydrocarbons, bound in porous materials above the water table, are flushed into the ground-water system during rainfall events or on occasions such as spring runoff when the water table is elevated into contact with the contaminated zone.

Since the intake setting of the pump in the Paranuik well is 10 feet below the water table surface, where the hydrocarbon was originally ponded, little more than the soluble hydrocarbons will enter the distribution system. Chromatographic analyses were unable to determine the presence of fuel oil in samples taken from the distribution system. Therefore, these samples contained less than the detectable limit of 0.5 ppm of fuel oil.

According to Gibbons[1] the odour of fuel oil cannot be detected in cold water (20°C) at concentrations of less than 0.3 ppm. Therefore, since odours were apparent in the water from the Paranuik distribution system, the fuel oil concentration must have been between 0.5 ppm and 0.3 ppm.

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1 Gibbons, M.M., "Water Pollution by Petroleum Oils" Journal American Water Works Association Vol. 32, page 465 (1940)

According to experimental work by Turnbull et al[2], a commercial, dissolved and floating kerosene at a concentration of 2990 ppm in cold water (20°C) proved toxic to 50% of the blue gill sunfish exposed to this environment for 24 hours. Fuel oil and kerosene have certain chemical similarities. Although more than 10,000 times the amount of petroleum hydrocarbons found in the Paranuik distribution system was required to kill these test fish, data demonstrating the long term effects of trace amounts of petroleum hydrocarbons on minnows are not available.

The above information was provided to Mr. Paranuik on April 18, 1973. Since an alternative water supply was not available for the minnows arriving within the week, Mr. Paranuik decided to continue the bait farming operation with the affected well water. According to Mr. Paranuik, the operation has been continued for seven weeks without apparent deleterious affects developing in the minnow population.

ALTERNATE SUPPLIES

Mr. Paranuik's property extends 165 feet from St. Lawrence Street in a south-easterly direction. It may be possible to drill a new, uncontaminated well at the south-eastern property extremity. However, there is no guarantee that such a well would not become contaminated in the future, especially if large amounts of water are withdrawn.

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2 Turnbull, H., De Mann, J.G., and Weston R.F., "Toxity of Various Refinery Materials to Fresh Water Fish." Symposium on Waste Disposal in the Petroleum Industry, Industrial Engineering Chemistry, Vol. 46, page 324 (1954).

RECOMMENDATIONS

As the lost fuel oil migrates downgradient, a hydrocarbon phase may reoccur in the vicinity of the Paranuik well. It is, therefore, recommended that the Paranuik well be inspected at one month intervals through the summer and fall of 1973. If a hydrocarbon phase is apparent at any time this should be pumped off and collected through gravity separation. This will insure the removal of as much of the lost product as possible from the ground water environment and allow only limited soluble quantities of fuel oil to enter the Paranuik distribution system.

If a new well is constructed as outlined above, the existing well should be pumped to waste on a continuous basis at a rate of about 1 gpm for the remainder of the bait farming season. This procedure would aid in confining the contaminant to the immediate vicinity of the existing well and in removing the fuel oil from the aquifer.

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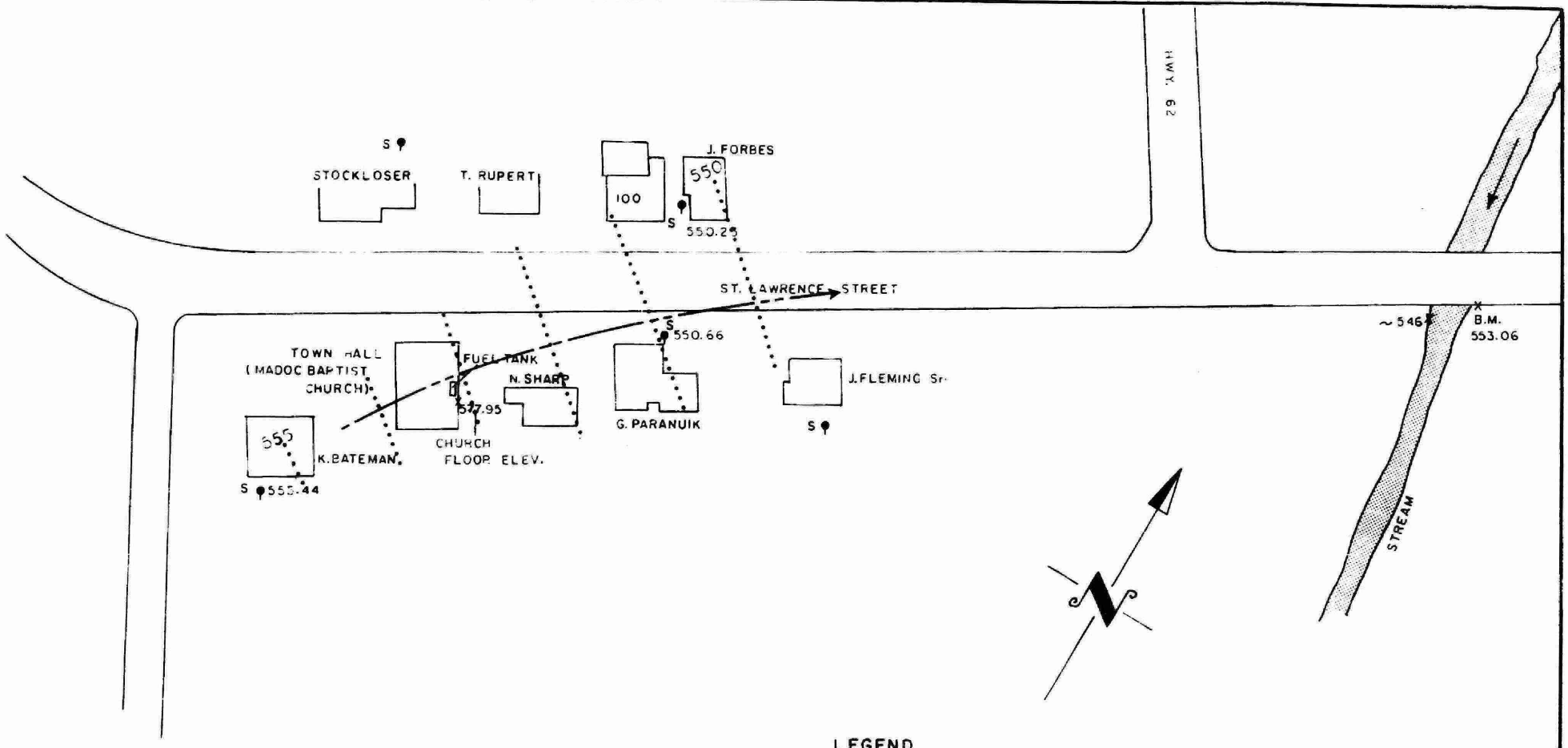

LEGEND

- ● DRILLED WELL IN BEDROCK
- 550.66 STATIC LEVEL ELEVATION
- 550 ····· POTENTIOMETRIC CONTOURS
- ——→ INFERRED GROUNDWATER FLOW DIRECTION
- S SAMPLED WELL

MINISTRY OF THE ENVIRONMENT
Water Quantity Management Branch

VILLAGE OF MADOC

FUEL OIL CONTAMINATION OF A PRIVATE WELL

Date: APR. 73	Scale: 1 IN. = 80 FT. (APPROX.)	Drawing No: FIGURE 1
Prepared by: D. S		

MINISTRY OF THE ENVIRONMENT

Table 1 Summary of Water Well Records

Date APRIL 73

Prepared by D. SMITH

Well No	Location and Elevation	con	lot	Owner	Driller	year	Well Type	Well Diameter (inches)	Depth (feet)	Static Level (feet)	Pumping Test (gpm)	(hrs)	Pumping Level (feet)	Quality	Use	Remarks, Log, etc
	113 ST. LAWRENCE STREET MADOC 583.87			K. BATEMAN			DR.	5		28.43				FR.	DOM.	
	98 ST. LAWRENCE STREET MADOC 572.69			J. FORBES			DR.	5	42	22.46				FR.	DOM.	
996	101 ST. LAWRENCE STREET MADOC 570.36			G. PARANUIK	Ed. TAYLOR	52	DR.	5	37	19.70	0.67	2		FR.	DOM.	Soil + Boulders 0-11 Hard Rock 11-37
971	ST LAWRENCE STREET MADOC.			STOCKLOSER	Ed. TAYLOR	47	DR.	5	37					FR.	DOM	Soil + Boulders 0-20 Hard Rock 20-37

Table 2 Summary of Water Analyses

Prepared by D. SMITH

Source and Number	Location	Date Sampled	Hydrocarbons ppm	Phenols ppb	Odour / Taste	Source and Number	Location	Date Sampled	Hydrocarbons ppm	Phenols ppb	Odour / Taste
S-1	REFERENCE SAMPLE FROM TOWN HALL TANK	APRIL 18/73	Fuel oil		—						
S-2	PARANUIK PUMP 15 MIN AFTER PUMP STARTED	APRIL 18/73	N.D		FAINT OILY SMELL						
S-3	PARANUIK PUMP 75 MIN AFTER PUMP STARTED	APRIL 18/73	N.D.		FUEL OIL ODOUR						
S-4	SURFACE OF PARANUIK WELL	APRIL 18/73	FUEL OIL-CHROMATOGRAPHY SHOWS IDENTICAL TRACE TO S-1 SAMPLE		REFERENCE						
S-5	BATEMAN HANDPUMP	APRIL 18/73	N.D.	—	NO ODOUR						
S-6	FORRES TAP	APRIL 18/73	N.D.	—	NO ODOUR						
S-7	FLEMING HANDPUMP	APRIL 18/73	N.D.	—	NO ODOUR						
	NOTE: N.D. - NON DETECTED DETECTION LIMIT FOR FUEL OIL IS 0.5ppm										